Human Preferences for Biodiversity in Agricultural Landscapes

Dissertation

zur

Erlangung der naturwissenschaftlichen Doktorwürde

(Dr. sc. nat.)

vorgelegt der

Mathematisch-naturwissenschaftlichen Fakultät

der

Universität Zürich

von

Xenia Junge

aus

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Zürich 2010

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General introduction

Land-use changes and agricultural intensification are among the major drivers of biodiversity loss on a global scale (Heywood 1995, Thomas et al. 2004, MEA 2005, Donald et al. 2006), threatening ecosystem functioning and services on which humans depend (Naeem et al. 1994, Hector et al. 1999, Spehn et al. 2005, Balvanera et al. 2006). The decline of biodiversity has led to widespread concern for a variety of ecological, ethical and aesthetic reasons (Ehrlich and Wilson 1991, Hector et al. 2001, Hooper et al. 2005, Naeem et al. 2009). In 2002, the Parties of the Convention on Biological Diversity committed themselves to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional, and national level (UNEP 2002). However, this cannot be done effectively without the participation of society at large, which has to be convinced of the importance of biodiversity if there is to be any real hope of implementing meaningful measures (Hanski 2005). As shown in previous studies some people may benefit from the exploitation of biodiversity (MEA 2005). Consequently, the willingness of people to confront the loss of biodiversity depends on the monetary value (e.g. as source for medicines, ecotourism) and non-market values (e.g. ethical, aesthetic) they attach to biodiversity (see discussion in Hooper et al. 2005). These values are not mutually exclusive, but may vary both within and among cultures, which must be taken into account to achieve conservation (Trombulak et al. 2004, Stokes 2007).

The case for biodiversity conservation can be argued on economic, sociocultural and aesthetic grounds (Balmford et al. 2002). Although biodiversity loss has occurred across all terrestrial ecosystems, many of its drivers are associated with the intensification of agriculture (Butler and Oluoch-Kosura 2006). Through intensified agricultural production fields have been enlarged and unproductive landscape elements such as hedgerows have been largely removed (Donald et al. 2002). The resulting habitat degradation together with increasing fertiliser input have been identified as the most important threats to biological diversity in agricultural landscapes (Benton et al. 2003, Donald et al. 2006, Kleijn et al. 2009). Moreover, homogeneously farmed landscapes lack typical elements of the traditional cultural landscape and result in less variation and complexity (Dramstad et al. 2001, Clergue et al. 2005). This reduces both the quality of the landscape experience and the historic and aesthetical value of cultured landscapes (Ewald 2001, Antrop 2005). However, an attractive landscape is highly important for both recreation and tourism (Ewald 2001, Buijs et al. 2006), and for the personal identification of people with their environment (Prohansky et al. 1983, Twigger-Ross and Uzzell 1996). As cultural landscapes in Europe are more and more approached as leisure-time commodities and less regarded as mere production areas (Vos and Meekes 1999, Buijs et al. 2006), sociocultural services, i.e. aesthetical, spiritual, psychological and other immaterial services of ecosystems, are receiving increasing attention (Butler and Oluoch-Kosura 2006).

Modern agricultural policy addresses these problems with an increasing share of direct payments for non-consumptive services of agriculture, so-called public goods (Potter and Burney 2002, Brady et al. 2009). The decoupling of partly area-related direct payments from production payments to reward multifunctional services represents a substantial reform of the Common Agricultural Policy (CAP) (Brady et al. 2009). These payments aim to secure the conservation of biodiversity and the sustainable development of the traditional cultural landscapes through, for instance, agri-environmental schemes (Vos and Meekes 1999, Potter and Burney 2002, Kleijn and Sutherland 2003, Potter 2006, Jongeneel et al. 2008). A multifunctional agriculture thus comprises the traditional production of goods as well as ecological, cultural and recreational services (Jongeneel et al. 2008). Since 1999, farmers in Switzerland can qualify for area-related direct payments if they meet a number of environmental standards (FOAG 2009). One of these standards demands that farmers have to manage at least 7% of their utilised agricultural land as so-called ecological compensation areas (ECAs). The catalogue of ECAs encompasses traditional landscape elements as well as new types of biotopes which were designed for the purpose of biodiversity conservation and of enriching the agricultural landscape (FOAG 2009). In alpine regions, farmers are encouraged with the help of subsidies to maintain or re-establish nutrient-poor grasslands in montane and subalpine zones which are currently strongly threatened either by abandonment or intensification (Chemini and Rizzoli 2003, Bolliger et al. 2007, FOAG 2009).

While the ecological effects of conservation measure have been largely studied (Kleijn and Sutherland 2003, van Buskirk and Willi 2004, Knop et al. 2006) little is known about the aesthetic value of conservation measures or of species rich, structural diverse landscape elements. However, studies by Tahvanainen et al. (2002) and Schüpbach et al. (2008) indicate that agri-environment schemes can have positive impacts on the visual quality of landscapes. Research on the valuation of natural landscapes has shown that people valuate natural environments as more positive than urban or human-influenced environments (extensive reviews in Ulrich 1986, Kaplan and Kaplan 1989, Ulrich 1993, Coeterier 1996). Moreover, contact with nature has been found to promote restoration from psychophysical stress (Ulrich et al. 1991, Hartig et al. 2003) and mental fatigue (Hartig et al. 1991). However, within the field of landscape aesthetics several theories for explaining landscape perception and preferences can be found. Evolutionary theories explain visual landscape preferences by biological and evolutionary principles (Appleton 1975, Orians 1980, 1986, Kaplan and Kaplan 1989), claiming that we respond positively to features that enhance survival and well-being. On the other hand, 'humanistic' or 'cultural' preference theories (Tuan 1974, Carlson 2001) argue that attitudes, beliefs and ideas of each individual observer are in a constant change and shaped by cultural and personal experiences, with beauty being in the eye of the beholder (Meinig 1976, Dearden 1987, Lothian 1999). In an attempt to resolve the conflict between biological and cultural explanations of human responses to nature, Bourassa (1991) argues in his 'theoretical framework' that both biological and cultural factors are important determinants of human-nature transactions. In his integrative approach landscape perception and preference are explained as genetically based but modified and changed by cultural influences and personal experiences.

The 'cultural' dimension of landscape experience is, for example, influenced by symbolic meanings of typical or unique landmarks (Appleyard 1979, Nohl 2001), by the meaning people attach to a landscape (Greider and Garkovich 1994) and by feelings and imaginations visible things evoke in a viewer, e.g. peacefulness or freedom (Nohl 2001). The concept of 'sense of place' comprises the meanings, attachment, and satisfaction people associate with a particular place (Stedman 2003). Moreover, the attachment to a place or landscape can support and develop personal identity, i.e. place identity (Prohansky et al. 1983, Twigger-Ross and Uzzell 1996). Another people-place relationship is familiarity (knowledge of a place). Some authors have found familiarity to be a particular strong predictor for landscape preferences (Wellman and Buyhoff 1980, Hammit 1981, Lyons 1983). In addition, aesthetic preferences may differ across demographic groups (e.g. Balling and Falk 1982, Lyons 1983) or according to environmental value orientations (Kaltenborn and Bjerke 2002).

Most studies of landscape preferences have, however, focused on the biological dimension of landscape aesthetics. Orians (1980, 1986) suggested that humans have a genetically based preference for savannah-like environments as the savannah is probably the landscape of the first humans. The most widely accepted theories to explain this idea are the prospect-refuge-theory (Appleton 1975), and the information-processing-theory (Kaplan and Kaplan 1989). The prospect-refuge-theory stresses the importance for our ancestors (as being predators *and* prey) of living in an environment with the possibility to 'see without being seen' (Appleton 1975). The information-processing-theory of Kaplan and Kaplan (1989) postulates that people will have two basic needs to survive in the environment: to understand

and to explore. Out of these needs, four 'informational variables' were created: coherence (immediate understanding), complexity (immediate exploration), legibility (inferred understanding) and mystery (inferred exploration). All four informational variables have been identified as important predictors of environmental preferences (Kaplan and Kaplan 1989, Gifford 2002).

Recent studies have shown that complexity or diversity can have a positive impact on the scenic quality of landscapes (van den Berg et al. 1998, Hunziker and Kienast 1999, Dramstad et al. 2001, Tveit et al. 2006). However, few studies focus on what actually constitutes complexity with regard to landscape elements and how this relates to preferences (Tveit et al. 2006). Moreover, little is known about people's preferences for certain landscape elements and not just landscape as a whole, e.g. whether the species-richness of a landscape element (diversity on a smaller scale) is preferred. Recently, it has been found that species-richness and structural diversity was an important feature when participants were asked to create their own favourite meadow patch (Lindemann-Matthies and Bose 2007). Furthermore, Fuller et al. (2007) could show that psychological well-being increased with increasing species-richness. Biodiversity as a predictor variable in studies investigating preferences for natural versus managed scenes has also shown positive effects (Strumse 1996, van den Berg et al. 1998, Dramstad et al. 2001, Natori and Chenoweth 2008). Nevertheless, group differences have been found, showing that for farmers, biodiversity was negatively related to scenic beauty (van den Berg et al. 1998, Natori and Chenoweth 2008).

In agricultural areas, environments with high species richness are typically elements which are set-aside from production or used at low intensity. However, there is concern that farmers might not like un-maintained 'wild' environments as they are competing with the need to maintain suitable preconditions for intensive farming (Soini and Aakkula 2007). Moreover, they might look 'scrubby' which differs from the conventional 'horticultured' landscapes people are used to (Nassauer 1988, Nassauer 1995, Parsons 1995, Breuste 2004). In addition, lay persons ideas about biodiversity are rather vague (Soini and Aakkula 2007, Lindemann-Matthies and Bose 2008), and it is hardly known whether people can actually distinguish between species poor and species rich plant communities, and whether increasing species richness increases people's appreciation of a plant community. As conservationists to date have devoted little attention to human biodiversity perception and preferences, it is poorly understood which components of biodiversity will appeal to people (Little et al. 2001, Stokes 2007). Moreover, there is a lack of knowledge about the acceptance of natural or semi-natural, species-rich landscape elements (Breuste 2004). Thus, for sustainable conservation measures in agricultural land, knowledge on the acceptance of semi-natural environments harbouring high biodiversity is of crucial importance. Therefore, detailed data on the public's perception of and preferences for biodiversity and species-rich elements in the agricultural landscape are needed.

Thesis outline

This thesis is concerned with biodiversity perception of grassland vegetation and landscape preferences for Swiss agricultural landscapes as well as for single landscape elements. Contributions are made to (1) the understanding of the public's perceptions and appreciation of biodiversity, (2) the acceptance of agro-environmental measures for biodiversity conservation, (3) the aesthetic valuation of agricultural elements with different species richness and structural diversity, (4) the aesthetic valuation of agricultural landscapes with differing heterogeneity, and (5) differences of landscape preferences related to farming background and other background characteristics of study participants.

In **chapter 1** we investigated with a series of manipulative experiments and field studies the perception of biodiversity of grassland ecosystems by lay persons, and whether biodiversity represents an aesthetic value for humans. The design of the experiments was analogous to that of diversity-ecosystem functioning experiments (Hector et al. 1999, Schmid et al. 2002). However, to study diversity effects of larger, natural communities, people who passed field plots of different diversity were asked about their perception and valuation of grassland ecosystems.

In **chapter 2** the valuation and acceptance of species-rich field margins – an agro-environmental measure for biodiversity conservation – was investigated in an on-site survey. Field margins of different species-richness and composition were shown to 108 passers-by directly in the field. Study participants were asked about their perception and aesthetic liking of the field margin and about their opinion on field margins as a conservation tool in general.

Chapter 3 investigated the aesthetic preferences for different agricultural landscape elements. Photographs were used as visual stimuli. The elements presented were seven ecological compensation areas (ECAs) and seven crops. Moreover, seasonal variety was included in the study by showing each element in four to six seasonal stages. A random sample of four elements was sent to a random sample of 4000 Swiss households for aesthetic valuation. Furthermore, study participants were asked to characterise each element and to state general opinions about agriculture and the agricultural landscape in general.

In **chapter 4** landscape preferences of farmers and non-farmers for agricultural landscapes of the Swiss lowlands were investigated. With photo editing nine landscapes differing in their land-use type (arable dominated, grassland dominated or mixed) and in the proportion of ECAs (0%, 10% and 30%) were constructed. A photo questionnaire was sent to a random sample of 4000 Swiss households and 500 Swiss farmers. Study participants were asked to rate each landscape aesthetically. In addition, they were asked to characterise their most liked and most disliked landscape.

In a complementary study aesthetic preferences for alpine landscapes with differing land use (grassland, arable land), different proportions of species-rich grassland and different proportions of ecological compensation areas (ECAs) were investigated (**chapter 5**). With the help of 16 simulated colour images study participants (202 non-alpine Swiss residents) were asked to rate each landscape aesthetically and to characterise their most liked and their most disliked landscape.

These chapters are followed by a general discussion, summarising the findings from all studies and placing them in a larger context. Furthermore, potential applications are suggested.

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General discussion

In this thesis human preferences for biodiversity and semi-natural elements in agricultural landscapes were studied. We showed that plant diversity in itself is attractive to humans (chapter 1) and that the acceptance of measures for biodiversity conservation is high (chapter 2). We also demonstrated that varied, species rich and semi-natural elements are preferred to monotonous crops (chapter 3), and that agri-environment schemes as well as heterogeneous land use can increase the aesthetic value of landscapes (chapters 4 and 5).

It has been argued that aesthetic arguments for biodiversity conservation are not very convincing because people may find only few species aesthetically appealing and actually dislike many others (Hector et al. 2001). However, we showed that plant diversity in itself is attractive to humans (chapter 1). Our results therefore add attractiveness to humans to the list of ecosystem properties that are influenced by biodiversity. People found those communities most aesthetically pleasing that were most diverse or were perceived to be most diverse. The true number of species present explained a significant additional proportion of the variation in appreciation, suggesting that people's appreciation may have been unconsciously influenced by true species richness. Many researchers argue that humans have an innate preference for structurally diverse landscapes as they enhance survival and well-being (Appleton 1975, Orians 1980, 1986, Kaplan and Kaplan 1989). It could be that humans also have an innate preference for biodiversity. This might provide an important argument for conservation as the conservation of biodiversity depends on the value people attach to it (Stokes 2007). A recent study indicates that also the well-being of people increases with species richness (Fuller et al. 2007). As natural settings in general were found to reduce psychophysiological stress (Hartig et al. 2003), it would be worthwhile to further investigate the relation between biodiversity and human well-being in different settings.

It has frequently been discussed that there might be a disjuncture between the ecological value of a landscape or semi-natural habitat and its visual aesthetic quality, leading to conflicts in the setting of conservation priorities and management aims (Nassauer 1988, Nassauer 1995b, Daniel 2001, Gobster et al. 2007). However, our results demonstrate that the important ecological aim of high diversity and the aim of aesthetic beauty can be compatible (chapter 1-5). Ecological compensation areas (ECAs), i.e. measures to enhance farmland biodiversity, were highly favoured by the public in Switzerland compared to other landscape elements (chapter 2-5). Over all seasonal stages, ECAs received higher preference ratings than crops and were characterised as desired, beautiful and worth preserving (chapter 3). Moreover, landscapes with a high proportion of ECAs received the highest mean preference ratings both in the Swiss lowlands and the Alps (chapter 4 and 5). In a field study (chapter 2), the public strongly approved of the establishment of species-rich field margins, a new type of ECAs in the Swiss lowlands. The approval was not only due to the diversity and natural appearance of the margins, but also due to their ecological importance, for instance as a habitat for plants and animals. Our results are in line with a general growing nature-friendliness in Western countries (van den Born et al. 2001, Kaltenborn and Bjerke 2002, de Groot and van den Born 2003). The positive relation of ecology and landscape aesthetics is a pleasing result because ecologically sound landscapes are more likely to be sustained if they, in addition, evoke enjoyment and approval by the public (Nassauer 1997, Gobster et al. 2007). Moreover, the engagement of people with the environment can be enhanced through aesthetic landscape experiences (Gobster et al. 2007).

Compared to the influence of land-use type and the proportion of ECAs, socio-demographic variables explained very little of the overall variation in our models (chapter 3-5). Our results suggest that physical characteristics of landscape elements such as species richness are more important drivers of preferences than socio-demographic factors which is in line with other studies (Cook and Cable 1995, Daniel and Boster 1976, Hagerhall 2001, Hull and Revell 1989, Ode et al. 2009). However, familiarity also influenced preference ratings of landscape elements positively, although to a lesser degree (chapter 3). Most likely due to familiarity, arable crops were preferred in the Swiss lowlands, whereas grasslands were preferred in the Swiss Alps (chapter 4 and 5). However, cultural and personal aspects such as familiarity can change over time (Hunziker et al. 2008), and interact in a feedback loop in which culture structures landscapes and landscape shapes culture (Nassauer 1995a).

The increasing intensification of agriculture leads to homogenisation of agricultural landscapes through increased fertiliser input and removal of unproductive landscape elements (Donald et al. 2006, Kleijn et al. 2009), and to reduced species richness of grasslands (Zechmeister et al. 2003, Clark and Tilman 2008). This is likely to reduce the attractiveness of grasslands for people (chapter 1), especially in regions such as the European Alps where grasslands are a dominant feature. We could show that alpine landscapes dominated by species-rich grassland and ECAs were preferred over those dominated by species poor, intensively used grassland with only few ECAs (chapter 5). A loss of species-rich grassland and landscape heterogeneity in the Alps could thus have negative consequences for tourism. The demonstrated higher attractiveness of species-rich vegetation and structural landscape elements may thus also add an economic argument for the conservation of biodiversity and semi-natural landscape elements.

The present results are in contrast to a widespread concern that ecological sustainability and farmers' aesthetic preferences are incompatible (van den Berg et al. 1998). Farmers were found to be less negative about ECAs than generally assumed (chapter 4). Our results might thus help to motivate farmers to overcome barriers against the adoption of agri-environment schemes, because the experiences and opinions of neighbouring farmers (Vogel 1996, Vanslembrouck et al. 2002) as well as the opinion of the non-farming public can positively influence the attitudes of farmers towards environmental schemes (Berentsen et al. 2007, Herzon and Mikk 2007). Moreover, scenic beauty not only depends on the amount of ECAs in a landscape but also on management skills of the farmers. However, farmers are often not aware that both ecological and aesthetic quality not only depends on the environmental conditions of the respective area, but also on the care and management provided by themselves. For the acceptance of environmental schemes among the farmers' community it is important that farmers realize that they can show their skills and performance not only with a neat and orderly farmed landscape but also with the care and management of ECAs (Burton et al. 2008). Practitioners, educators and policy makers are thus encouraged to find means of filling the gap between non-farmers' and farmers' views of agri-environment schemes such as ECAs, for instance, in the farmers' education.

The integration of people's aesthetic preferences is seen as a vital component of today's landscape planning (Kaplan et al. 1998, Nassauer et al. 2001, Breuste 2002). This is particularly important as today's agricultural landscapes are 'everyday' landscapes for many people in densely populated countries or regions such as the Swiss lowlands (Dramstad et al. 2001). As the importance of landscapes for individual and social well-being and the demand for recreation in the cultural landscape are increasing (Council of Europe 2000, Buijs et al. 2006), it is of crucial importance to find means for a sustainable future of the cultural landscape with all actors involved (Vos and Meekes 1999). If landscape planners want to meet the public's preferences in designing agricultural landscapes, the strong preference for biodiversity and heterogeneity in agricultural landscapes should be taken into account (chapter 1-5).

However, a lack of an easily accessible methodology to deal with the visual landscape issue frequently hampers the inclusion of visual aspects in landscape planning (Dramstad et al. 2006). The present results can help filling a gap providing aesthetical values of typical agricultural landscape elements, which now could be included in scenic beauty estimation methods. Because the existing quantitative methods to capture the scenic beauty in particular agricultural regions are from the 1980ies (Grosjean 1986, Hoisl et al. 1989), there is a need of future research to develop or to update such methods (Schüpbach 2000).

According to the European Landscape Convention the landscape should become a mainstream political concern (Council of Europe 2000). Our results lead to the conclusions that (1) agro-environment schemes are not only important for conservation, but also for landscape aesthetics, and that (2) agricultural practices (land use and proportion of ECAs) can highly influence the aesthetic value of agricultural landscapes and might thus have an influence on the public amenity agriculture provides for recreation. This highlights the importance of visual landscape aspects in agriculture and we thus recommend the integration of landscape aesthetics into agricultural policy. In this regard, the present results might help to develop area-related direct payments for agricultural practices which increase landscape aesthetics (Schüpbach et al. 2009). A helpful tool for the definition of direct payments for landscape aesthetics as an agricultural service might be a computer program to assess the scenic and recreational value of farms which was recently developed in Germany (von Haaren et al. 2008).

Experts and decision makers in Switzerland agree that modern agricultural landscapes should have high ecological value and provide opportunities for recreation (Huber et al. 2007). Nowadays, intensive production alone is not sufficient for agriculture to be supported by society as it is a mixture of food production and the provision of semi-natural environments that people expect (Buijs et al. 2006, Jongeneel et al. 2008). Thus, the current preferences for agricultural landscapes found by this thesis help to substantiate the management and development of cultural landscapes in ways that they are both valuable in ecological terms and attractive to humans.

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Dank

Ein herzliches Dankeschön an alle, die in vielfältiger Art und Weise zum Gelingen dieser Arbeit beigetragen haben! Insbesondere geht mein Dank an:

Petra Lindemann-Matthies und **Beatrice Schüpbach** für die äusserst engagierte und kompetente Betreuung dieser Dissertation. Ich konnte sehr von den unterschiedlichen fachlichen Kompetenzen beider profitieren, was sehr zum Gelingen der Arbeit beigetragen hat.

Petra möchte ich für ihre begeisternde und motivierende Art der Betreuung herzlich danken. Ich konnte von ihr in den letzten Jahren sehr viel lernen und empfand die Zusammenarbeit sowohl fachlich als auch persönlich sehr bereichernd. Zudem schätzte ich ihre gründliche und schnelle Korrektur von Manuskripten und ihre grosse Hilfsbereitschaft, ‚wenn's darauf ankommt'! Auch unsere Gespräche ausserhalb der Wissenschaft waren immer sehr erfrischend und die herzliche und fröhliche Atmosphäre in ihrer Arbeitsgruppe habe ich sehr genossen.

Ohne **Beatrice** wäre meine Dissertation nicht in die Wege geleitet worden. Für die Projektidee zu Kapitel 3 und 4 („Ästhetische Wertschätzung der Agrarlandschaft“) und ihre grosse Unterstützung in diesem Projekt danke ich ihr daher herzlich! Ihr fachliches Wissen zu Agrar(landschafts)themen war mir sehr hilfreich und ohne ihre GPS- und GIS-Unterstützung hätte ich meine Foto-Standorte nicht wieder gefunden! Sie hatte für Anliegen und Fragen immer Zeit, was ich ebenso schätzte wie ihre konstruktive Kritik und wertvollen Anstösse zu meiner Arbeit.

Bernhard Schmid danke ich dafür, dass ich die Doktorarbeit sowohl am IfU als auch am Reckenholz durchführen konnte. Seine umfassenden Statistikkenntnisse waren sehr lehrreich für mich und ich habe es geschätzt, das er sich immer Zeit für dringende Fragen und Besprechungen genommen hat.

Marcel Hunziker danke ich für die Übernahme des Co-Referats und für viele konstruktive Diskussionen zur Fragebogengestaltung. Auch konnte ich viel über Theorien zur Landschaftswahrnehmung von ihm lernen.

Der **Begleitgruppe** zum Projekt „Ästhetische Wertschätzung der Agrarlandschaft“ danke ich für angeregte Diskussionen und konstruktive Kritik bei unseren halbjährlichen Treffen. An dieser Stelle möchte ich auch dem **Bundesamt für Landwirtschaft** für die finanzielle Unterstützung dieses Projektes danken.

Thomas Walter danke ich für seinen Beitrag zur Projektidee „Ästhetische Wertschätzung der Agrarlandschaft" und als Projekt-Mitantragsteller für die wertvolle Unterstützung im Projektantrag. Ihm sowie **Felix Herzog** danke ich dafür, dass ich sowohl am Reckenholz in der Gruppe „Agrarlandschaft und Biodiversität" als auch am IfU meine Arbeit durchführen konnte. Hierdurch habe ich interessante Einblicke in zwei Forschungsgruppen erhalten, die meinen wissenschaftlichen Horizont erweitert haben. **Felix** danke ich zudem für die kritische Durchsicht der Manuskripte von Kapitel 4 und 5.

Für die kritische Durchsicht und sprachliche Korrekturen der Manuskripte sowie für wertvolle Hilfe bei Statistik-Fragen möchte ich zudem **Diethart Matthies** herzlich danken.

Allen **IfUs** danke ich für die vielen Gespräche, unterhaltsamen Feiern und für die angenehme und persönliche Atmosphäre an diesem tollen Institut. Insbesondere geht ein grosses Dankeschön an ...

... **Isabel Schöchli** für ihr grosses Engagement nicht nur in administrativen Dingen, die von komplizierten Massen-Couvert-Bestellungen für die Umfrage bis zu freundlichen Aufmunterungen in Stressphasen reichten.

... **Reinhold Briegel** für die gute Zusammenarbeit während seiner Diplomarbeit und seinen wertvollen Beitrag zu unserem Projekt sowie für erstklassige Fotobearbeitung der Fragebogenfotos.

... **Daniel Gregorowius** als Mit-Doktorand in Petras Gruppe für gute Gespräche und angeregte Diskussionen.

... meine Bürokolleginnen **Susann Eichenberger**, **Maja Weilenmann** (und ehemals) **Jasmin Joshi** für eine immer angenehme und herzliche Atmosphäre in unserem Büro.

... **Eva Voijtech**, **Steffi von Felten**, **Jana Petermann** und **Thomas Schulz** für viele lebendige Gespräche, gemeinsame Mittagessen oder gelegentlich auch „Olten-Treffs" sowie die Motivation für meinen Endspurt!

Allen **Reckenhölzlern,** vor allem in der Gruppe „Agrarlandschaft und Biodiversität" danke ich ebenfalls für eine immer gute und angenehme Atmosphäre, durch die ich mich immer wohl gefühlt habe. Insbesondere geht ein herzliches Dankeschön an ...

... meine Bürokolleginnen **Lisa Eggenschwiler** und **Katja Jacot** für die immer heitere

Stimmung im (lange Zeit) „Frauenbüro“, für die Hilfsbereitschaft bei diversen Fragen und für anregende Gespräche sowie aufbauende Worte in der Endphase.

... **Stephan Bosshart** für seinen Erfindungsgeist bei technischen Problemen (z.B. wie fotografiere ich 2 Meter hohen Mais von oben?) und die gute Stimmung, die er immer verbreitet.

... **Gaby Brändle** für ausgezeichnete Fotobearbeitung.

Auch danke ich **Flurina Schneider**, **Karina Liechti** und **Franziska Schmid** von der „Diss-Lese-Gruppe Bern“ für den inspirierenden Austausch in unseren Paper-Diskussionen.

Stephan Bosshart, **Lauren Cottle**, **Lisa Eggenschwiler**, **Daniel Gregorowius**, **Robert Home**, **Jean-Yves Humbert**, **Peter Huonker**, **Mimoza Hyseni**, **Oksana Ignatuk**, **Sibille Jenni**, **Tina Neumann**, **Suse Nies** und **Maja Ravaioli** danke ich für die Mithilfe beim Fragebögen verpacken!!!

Nicht zu vergessen sind alle Personen, die meine Fragebögen ausgefüllt haben und so zur Verwirklichung dieser Arbeit beitrugen.

All meinen Freunden, insbesondere **Tina**, **Suse** und **Nele**, danke ich für ihre Ermunterungen und dass sie mich immer mal wieder auf andere Gedanken gebracht haben.

Von ganzem Herzen möchte ich auch meinen **Eltern** für Ihr Interesse an meiner Arbeit, ihre Ermunterungen und Unterstützung danken. Meiner Mutter möchte ich an dieser Stelle für ihren riesigen Einsatz, Levin regelmässig zu betreuen, ein besonders grosses Dankeschön aussprechen.

Meinem kleinen Sohn **Levin** danke ich von Herzen für seine Fröhlichkeit und Unbekümmerheit, die der schönste Ausgleich zu meiner Arbeit waren.

Mein grösster Dank gilt meinem Mann **Christian** für seine riesige Unterstützung vor allem in der Abschlussphase dieser Arbeit, für die freitägliche Papa-Präsenz und sein Multi-Management, um mich so gut es irgend ging zu entlasten. Nicht weniger bedeutend waren sein Verständnis und seine aufbauenden und motivierenden Worte, die mir viel Halt gaben.

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Liste der Publikationen

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